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ABSTRACT

This hypertext paper provides teachers and parents with a broad overview of electronic literacy (literacy activities which are delivered, supported, accessed, or assessed through computers or other electronic means) in school and home, and includes links and references which can be pursued for specific practical detail. Definitions of tests, hypertexts, and hypermedia lead to a discussion of changes in the definitions of reading and literacy. The paper reviews current developments in electronic literacy in five main categories. It then considers linking electronic literacy activities between home and school. In this context, access and equity issues are reviewed and the practicalities of simpler alternative multimedia technologies explored, particularly with reference to international perspectives. The paper then discusses the development of global electronic literacy from the home independent of the school. Future problems, opportunities, and developments are foreshadowed; action implications for practitioners and researchers discussed; and issues of effectiveness emphasized. Contains 83 references. (RS)

Electronic literacy in school and home: A look into the future

Keith J. Topping

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This hypertext provides teachers and parents with a broad overview of electronic literacy in school and home, and includes links and references which can be pursued for specific practical detail. Definitions of texts, hypertexts, and hypermedia lead to a discussion of changes in the definitions of reading and literacy. Current developments in electronic literacy are reviewed in five main categories. Linking electronic literacy activities between home and school is considered. In this context, access and equity issues are reviewed and the practicalities of simpler alternative multimedia technologies explored, particularly with reference to international perspectives. The development of global electronic literacy from the home independent of the school is then discussed. Future problems, opportunities, and developments are foreshadowed; action implications for practitioners and researchers discussed; and issues of effectiveness emphasised.

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Introduction

Texts, hypertexts, and hypermedia

For centuries, from long before the development of the printing press, almost all writing systems on our planet have been linear -- a line of symbols read sequentially. Texts have been in one dimension -- length. True, fitting the line of symbols onto conveniently portable pieces of some recording medium often involved breaking the line into sections -- the sections then being scanned continuously from left to right, right to left, or up and down.

However, in electronic literacy environments, linear text is being replaced by hypertext. A hypertext contains many segments of linear text which are designed to be accessed by the "user" in any order via embedded structural electronic links. Chosen segments are scanned strategically rather than in a continuous linear way. Hypertexts also contain links to other hypertexts, enabling users to easily explore other relevant materials if they choose. Thus, hypertexts can be construed as a large set of parallel texts with many possibilities for strategic movement among them. They are in effect three dimensional. Hypertexts are a network of possibilities. It is difficult to define their boundaries -- just where do they begin and end?

Hypertexts are a different way of organising and linking symbolic information. Hyper**media** approaches go beyond textual symbols. They combine on-screen text with static pictures, moving pictures and graphics, and increasingly sound and vision, while also having the organisational features of hypertext. Thus, hypermedia programmes (often on CD-ROM) typically also offer much faster search and interactivity facilities than regular books, many alternative paths to follow from decision points, interactive questioning, suggestions for onward classroom exploration, and so forth. In schools, teachers are becoming ever more sophisticated in their use of multimedia and hypermedia, with the support of resources such as Heide and Stilborne (1997) and "Online-Offline."

Of course, traditional books in regular linear text often have pictures. For some years teachers have used sound and video as a stimulus to subsequent reading and writing of linear text. Audiotaped books, enabling reading while listening, are also multisensory. So what's new? It is true that all these could be considered **multi**media approaches, and to an extent involve parallel flows of information? Indeed, they remain very valuable for students who as yet do not have access to modern electronic literacy hardware and software. However, they lack the organisational features, variety, and immediacy of interactivity which characterises **hyper**media -- although the dividing line is not clear cut.

These changes in the nature of texts and other media are coupled with changes in the nature of the interaction between the medium and the user. "Reading" is not what it used to be.

What is reading, in the Electronic Age?

Current everyday thinking about reading often assumes it is an activity related to linear text. In fact, the definition of reading was never as narrow as that. From roots in the Old High German, the *Oxford English Dictionary* defines reading as "to inspect and interpret the meaning of signs or marks." Thus a thermometer is "read," and a tracker "reads" marks on the ground, for example.

Reading in a hypertext environment involves the "reader" in cognitive reconstruction to suit his or her own requirements and specifications -- only certain aspects of the material are relevant to his or her own individualised voyage of discovery. Of course, this is to some extent true of traditional linear texts -- but much more true of hypertexts.

Reading a hypertext is unlike the continuous scanning of linear text and more like the "reading" of tea leaves, someone's palm, entrails, dreams, or the clouds. It is a search for personal relevance, an exploration of the most salient points in relation to the needs of the reader and in relation to each other. It involves more frequent and more overt selectivity on the part of the reader -- and thus potentially both more partial understanding and deeper understanding.

Eighty years ago, Thorndike (1917) described the process of reading comprehension thus: "Understanding consists of selecting the right elements of the situation and putting them together in the right relations with the right amount of influence for each -- the mind must select, repress, soften, emphasise, correlate, and organise, under the influence of the right mental set or purpose or demand." He must have foreseen the advent of the hypertext.

Indeed, using a hypertext is perhaps more like "navigation" than "reading" -- to navigate is "to manage or direct the course of an expedition or exploration" -- again, by judicious use of signs (but not necessarily symbols). Certainly "reading" hypertext requires more active strategic management by the reader -- with obvious implications for metacognition and thinking skills.

Electronic literacy

As reading is changing, so is literacy. Notions of literacy are expanding and the definition of literacy developing as we progress from the Typographical Age into the Electronic Age.

"Electronic literacy" refers to literacy activities (such as reading, writing, and spelling) which are delivered, supported, accessed, or assessed through computers or other electronic means rather than on paper. (Note that the term "electronic literacy" should not be confused with "computer literacy," the latter expression often being applied to knowledge and competencies in using computers generally, for example keyboard skills, familiarity with the Windows environment, and so on.)

However, electronic literacy is not just an additional component to our existing definition of "literacy," it has the potential to transform the whole definition (Reinking, McKenna, Labbo, & Kieffer, 1997; Tuman, 1994).

Current developments in electronic literacy can be considered in a number of categories: electronically supported reading, electronically supported writing, electronic audiences, electronic literacy assessment, feedback, and management, and electronic direct speech-text conversion. In all these areas some far-reaching developments are happening.

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Electronically supported reading

Much of the early commercial reading software offered little more than regular linear text, but on screen -- less portable and reliable than a book and often more difficult to read. The relationship to research on effective pedagogy was often tenuous.

However, even a decade ago the better computer programmes were already demonstrating effectiveness in raising literacy performance in adults in comparison to control groups, let alone in children (Wangberg, 1986). Increasingly, modern adaptive computer programmes seek to scaffold and prompt successful reading (Reitsma, 1988).

Reinking and Schreiner (1985) and Reinking (1988) found that fifth- and sixth-grade students in fact read text equally effectively from paper or screen, but adaptive software which enabled the reader to select support in the form of definitions of key vocabulary, a simpler version of the text, supplemental contextual information, or an indication of the main idea for each paragraph resulted in more effective reading than either, especially on passages of high difficulty.

Salomon, Globerson, & Guterman (1989) evaluated the insertion of metacognitive prompts (questions, strategies, and reminders) into a simple programme called The Reading Partner. The experimental group showed superior reading comprehension and essay writing. Reinking and Rickman (1990) found support for readers through definitions of key vocabulary more used by students and more effective if presented by computer rather than on paper.

The addition of voice recognition, speech synthesis, and digitised speech takes the idea of electronically supported reading a stage further. Programs now enable machines to "hear" beginning readers and/or give individualised discriminatory prompting or corrective spoken feedback to promote oral reading accuracy (see, for example, Davidson & Noyes, 1994, 1995; Goodman, 1994; Hartas, 1994; Moseley, 1992; Van Daal & Reitsma, 1993).

More recently, McKenna and Watkins (1996) and McKenna (1997) described the use with beginning and disabled readers of electronic "Talking Books" (not to be confused with the audiotaped "Talking Books" described by Carbo in 1978 and discussed later). Students could choose to hear digitized pronunciations of individual words. However, in practice they accessed such support on some words they already knew and failed to access it on some words they did not know.

Results from this and previous studies were nevertheless encouraging, suggesting that increased engagement and practice was itself a powerful factor, since the students learned many new words in addition to those for which support was accessed. It seems such supported texts can indeed extend the student's zone of proximal development. They also lend themselves to repeated readings, and metacognitive instruction and comprehension monitoring can be arranged in parallel as the teacher sees fit.

Examples of commercial "talking" reading support programs are Wigglewor ks, KidTalk, KidWorks Deluxe, ULTimate Reader, and Acceleread. Living Books produced by Broderbund on CD-ROM have text and pictures with student self-selected digitised speech, second language versions, the option of playing instructional games, and various special effects. Similar offerings from other publishers can be found in the Publishers Weekly Multimedia Directory and the Storybook Software listings.

Horney and Anderson-Inman (1997) and Anderson-Inman and Horney (in press) review their ElectroText programme, which supports text in a wide variety of sophisticated ways. The embedded resources can be categorized as translational (for English as a second language students), illustrative (including video), summarizing, instructional, enrichment, notational, collaborative, and general purpose. Students select the type and degree of help necessary. The authors also discuss design criteria for universally accessible documents.

But what about students who are unfamiliar with keyboarding or have specific learning disabilities? The ULTimate Reader programme mentioned earlier incorporates visual highlighting as selected by the student, bilingual Spanish with customized pronunciation, different speeds and chunking of speech feedback, and auditory prompting for visually impaired users. Programs such as Computer Campus include specific keyboard skills tutorials, and enable multiple choice of screen colour, text colour, font, and font size -- the latter to accommodate for any scotopic sensitivity syndrome and obviate any need to wear coloured lenses.

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Electronically supported writing

The use of a word processor in the classroom has been shown to improve the quality of student writing (Bangert-Drowns, 1993). Beyond this, predictor programmes which also scaffold and prompt the writing process are increasingly common and increasingly sophisticated.

When the student is unsure what to write next, the machine prompts with alternatives. The computer remembers and integrates more and more about each individual child's most frequently used vocabulary, including special people and place names, as well as the child's typical constructional style. Its prompting becomes ever more attuned to the individual child's natural writing "personality." Thus the child and the machine can perhaps truly be said to have developed a relationship, which is individualised, interactive, and adaptive. The child is no longer "using" the machine, but the child and machine are collaborating, combining human and artificial intelligence.

Examples of current predictor programmes include Prophet, Penfriend, Co-Writer, PAL

(Predictive Adaptive Lexicon), TextHelp, EZ Keys for Windows, and Creative Writer 2.

Beyond this, there are programmes which prompt in speech rather than on screen -- "talking word processors." Examples include TextHelp, Co-Writer, Write:Outloud, Textreader, IntelliTalk, TalkWrite (info@resourcekt.co.uk), KidWorks, Accelewrite, Talking Word for Windows, Talking P enDown, The Writing Set, Adult Literacy Word Processor, ULTimate Reader, Writer's Toolkit 2 (enquiries@scet.org.uk), Talking Textease, and Pages (info@semerc.demon.co.uk) (the last two also include desktop publishing facilities).

Against this background, the old-fashioned word-processing spell checker begins to seem like something from the Stone Age. Modern, adaptive, prompting spell checkers (such as PAL Speller) do not just give the child the correct spelling, but also support the child in figuring it out for him or herself. They do not just take over the human function, but engineer effective human learning, while enabling the child to complete the task without undue stress or sense of failure. The "talking spell checker" is increasingly commonplace and many of the talking word processors have this built in.

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Electronic audiences

Teachers and parents sometimes worry about kids spending hours in isolation playing with their computer. However, electronic literacy can equally offer children wider socialisation and an expanded view of potential audiences for their creations.

Teachers have often had older students make reading books for younger ones, or students make books to circulate among their classmates, or students write letters and journals to peers in another school, locally or far away. Computers enable self-made books to be produced to a far higher standard of finish in less time.

Increasingly, students write to electronic mail pals on the other side of the world (sometimes receiving a reply or other feedback within minutes), or participate in an international exchange of news and views through an e-mail group listserver, or collaborate in producing regular issues of an electronic journal, or create material for the school's World Wide Web home pages (Garner & Gillinghani, 1996; Leu & Leu, 1997).

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Electronic literacy assessment, feedback, and management

Computers can also assess reading. Computer-mediated texts with embedded comprehension questions, which prompt the reader to review the relevant section of text if the questions are answered incorrectly, have been evaluated (Reinking & Pickle, 1997), as have multimedia book reviews (Reinking & Watkins, 1996).

Programmes for student self-assessment of silent reading comprehension of literature which give immediate and enhanced feedback are increasingly sophisticated (Paul, 1996; Paul & Topping, 1996; Vollands, Topping, & Evans, 1996). Students can self-test on books read

at home and school, including those read to and with the students, perhaps using the Duolog Reading technique (Topping, 1997a). In addition to providing analysis and reports for the teacher, such software also generates take-home reports to promote parental involvement. Some parents are also interested to come into school to sit in on the child's self-test and celebrate the outcome -- and some teachers and parents put themselves in the programme!

These programmes can be coupled with newly available norm-referenced (standardised) reading tests delivered, scored, and interpreted by computer. Not only can such tests save a great deal of teacher time, they reduce child testing time by their adaptive nature, presenting only individually selected items to quickly determine the child's functional level. Furthermore, their large item banks mean children never take the same test twice, so they can be used repeatedly if the teacher wishes without being biased by practice effects or cheating. For children with reading difficulty, computer-based diagnostic tests designed to identify, for example, dyslexia might offer greater objectivity and consistency (Singleton, 1994). Some of these computer-based assessments also generate prescriptive advice for the teacher and the child about how to improve the child's performance level.

Additionally, for those teachers interested in continuous portfolio assessment, the portfolio will increasingly be kept in electronic form (Kieffer, Hale, & Templeton, 1997).

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Electronic direct speech-text conversion

Teaching writing in schools might become of doubtful relevance when a computer can reliably transform speech directly into writing -- and writing directly into speech. Writing with paper and pencil could become a survival skill, like making fire by striking sparks. This is not a futuristic vision; the technology already exists and is in everyday use.

Examples of speech-to-text programs are Kurzweil Voice and VoicePad, VoiceText, Dragon Dictate (for IBM) and PowerSecretary (for Macintosh), IBM VoiceType 3, Simply Speaking, and the Philips Dictation systems including Speech Magic and Speech Note. Some of these programmes are already available in English, Spanish, German, French, and Italian.

Some of the talking word processors listed earlier include text-to-speech possibilities, as do the following: Monologue 32 and ProVoice, TextAssist Text Reader, and DECtalk. Combined programmes which offer both speech-to-text and text-to-speech are fewer as yet, although one such is Keystone (effectively a combination of Dragon Dictate or IBM VoiceType with TextAssist).

One implication for schools is that teaching dictation skills might become much more important than teaching writing. The human is not redundant, but the machine performs some of the simpler functions more efficiently and thereby extends the human's capability -- in other words, this is "bionic writing."

At the moment, programmes for direct speech-text conversion take some time to learn to discriminate the voice of specific users, so any new user must tolerate an initial period of

slow going. Also, their basic vocabulary is not large, so each user needs to add a good deal of his or her own personal vocabulary to the programme lexicon. But all of this is improving rapidly, and plug-in extra vocabularies for specific subject areas are already available. Better voice analysis and synthesis systems will soon enable the computer to mimic the voice of the child (or the parent or the teacher or any other person), rather than sounding like a mechanical stranger.

Although one might think this technology is not portable, it is. Hand-held dictation machines which convert speech direct to text are already in use. When the user reaches a table top computer, he or she just extracts the mini-disc from the handset, puts it into the mini-drive, and prints, saves, or otherwise manipulates the file. Of course, Digital Audio Tape (DAT) recording lends itself to this process.

Now consider a combination of developments already described -- a machine to which the child speaks, which transcribes that speech into writing, while itself discriminately prompting the child in speech when the child hesitates too long or makes a syntactic, pronunciation, or factual error.

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Miniaturisation and the virtual library

Eventually books might be widely supplanted by portable electronic text readers the size of a book or smaller, into which miniature discs containing the text (and illustrations) of books are inserted. School or home libraries will thus take up only 10% of the storage space they occupy at the moment. Additionally, books (and other information) will be easily downloaded from the Internet onto such a disc, then read and further processed on the text reader anywhere.

Or the text reader may be taken to the neighbourhood public library to have its internal hard disc "filled up" with a book -- just like going to the gas station, except that networks will allow this to be done from home. So the public library will become a "virtual library" or electronic information centre, and its "stock" may be located anywhere. Only one copy of a "book" need be held electronically -- it can be multiplied instantly through many networks at a single keystroke. If this sounds far-fetched, try visiting the Internet Public Library or Kids Web Worldwide Digital Library for Schoolkids which already exist. Dropping the text reader during bath time reading might still prove problematic, though!

Thus far electronic literacy has been discussed on the assumption of application based in schools. However, for those with access, the potential for flow of worldwide information direct into the home is enormous. This hypertext proceeds to consider how schools can help promote the development of electronic literacy in the home. It then discusses how electronic literacy activities can develop independently in the home irrespective of any school involvement, with particular reference to international availability of information and communication.

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The electronic literacy home-school connection

Parental involvement in reading

Schemes to promote parental involvement in their children's reading at home typically involve the teacher giving guidance and lending school reading books to parents and children with a view to improving academic reading achievement and motivation in the children. The teacher orchestrates a triangular relationship. International research has demonstrated that this practice generally accelerates reading achievement in children (Topping 1995); Topping & Wolfendale, 1985).

Family literacy

The family literacy movement seeks to go beyond parental involvement in reading (Auerbach, 1995; Wolfendale & Topping, 1996). Family literacy embraces all aspects of literacy, not just reading. It targets gains in literacy competence, motivation, and self-image for all participants -- children and adults. It seeks to enable family members to help one another achieve such gains -- both intergenerationally and intragenerationally -- now and in the future. It values the existing home culture and competencies of family members and builds on these. It targets gains in literacy competence in relation to the needs, uses, objectives, and values of all participants, not just those of the school system (although it seeks to link the needs and competencies of the home or community and school environments so far as possible). It seeks to offer equal opportunities and access to all members of all families of all kinds.

In short, family literacy typically involves parent, child, and teacher as collaborative partners in engaging with print in the family's environment for the family's own purposes, to improve the achievement and motivation in many areas of literacy of the children and adults in the family, on a mutual and reciprocal basis. The effectiveness of this newer and more ambitious kind of work has been less well demonstrated as yet, although some early indications are encouraging (Benjamin & Lord, 1996; Educational Resources Information Center, 1995; Morrow, 1995, Morrow, Tracey, & Maxwell, 1995; Philliber, Spillman, & King, 1996; Wolfendale & Topping, 1996).

Family electronic literacy

The integration of electronic literacy with family literacy has been termed "family electronic literacy" (Topping 1997b; Topping, Shaw, & Bircham, 1997). The aims are similar to those for family literacy, but set in an electronic environment. In addition to literacy gains, participants might develop some transferable skills in the use of information technology.

For those family literacy workers struggling just to improve access to traditional linear books in socioeconomically disadvantaged homes, such possibilities might seem like a pipe dream -- yet there are already examples of innovative practice in the field. The five categories of electronic literacy outlined earlier could all have application in, and in relation to, the home.

Many manufacturers supply educational literacy programmes for home computer use, but

the quality of these is very variable, to put it charitably. Some are merely worksheets or other mechanistic drill and practice tasks presented on screen rather than on paper. Some bear little relation to either school or home literacy needs and curriculum, and at best serve as time-fillers. Some might actually conflict with the teaching the child is receiving in school rather than complementing it. Even the most sophisticated software does not necessarily produce learning which automatically generalises off the screen and into "real life." Furthermore, the rate of development in information technology is so rapid (some representing genuine advance, some merely built-in obsolescence), that even relatively wealthy and motivated families cannot keep up with it. Balajthy (see, for example, 1996a; 1996b) has produced helpful reviews of relevant software in the United States.

However, where compatible, functional and durable hardware and software is (or can be made) available, computer based inter generational literacy development is certainly possible and can lead to accelerated achievement gains (Maclay & Askov, 1987; 1988). Askov and Clarke (1994) make the point that computer programmes can offer feedback with privacy -- important for adults with restricted literacy who might be sensitive to their own errors when reading aloud. Nevertheless, just reducing the initial fears of adults about information technology itself might take time and effort, and as confidence begins to grow further specific training might prove necessary. It is likely that schools or other neighbourhood centres will be the best place for this to be provided, coupled with opportunities for social support.

Electronic literacy activities should certainly not be construed as only suitable for children of upper elementary school age and beyond. As with skiing and swimming, an early start pays dividends, as is demonstrated in the Screenland programme, involving kindergarten children taking laptop computers home to produce pictorial responses to literature using a computer drawing package (Labbo & Watkins, 1996).

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Access and equity issues in electronic literacy

The software and hardware needed for effective electronic literacy are costly, at least initially. Wealthy schools and families will be able to relatively advantage their students. There is already talk of the development of an "information underclass" -- the "digitally dispossessed."

However, costly software and hardware are not effective if not used or not used well: they are a means to an end, not an end in themselves. Thus the highly motivated child who is hungry to learn may only need a small marginal increment in available technology to make substantial strides forward.

Nonetheless, practical access and compatibility issues are very important in electronic literacy. From an international perspective, the range of need and current capability is vast, and real-life situations sometimes fraught with mismatch and paradox. The electronic delivery of education clearly has great potential in remote rural areas, but the infrastructure is rarely present. For instance, the government of one large South American country has recently decreed that all state schools are to have a computer installed -- despite the fact that a significant percentage still have no reliable electricity supply. Even in advantaged

countries and schools, pull-out (withdrawal) into computer labs might inhibit wider access and the perception of computers as an everyday all-purpose tool. Teacher inservice training and awareness and actual use of computers can lag far behind the availability of gleaming hardware.

Considering electronic literacy outside of school, many homes have no computer, especially outside the western industrial nations and in areas of relative socioeconomic disadvantage. Even where a computer is present in the home, the hardware platform (for example, Macintosh or IBM) and/or operating system (such as DOS or Windows) might be completely different to that used in school, so programmes and files cannot be transferred. This is a particular problem in the United Kingdom, where many local education authorities (school districts) have locked themselves into commitment to an often idiosyncratic hardware system, while parents are increasingly buying IBM clone machines for the home.

Electronic literacy in disadvantaged homes is difficult, maybe -- but not impossible. Hughes and Coyne (1996) described computer-based literacy learning for 58 Head Start families who were transported to a centre for the purpose. Parents and teachers attended sessions together. They started by exploring software for young beginning readers such as Munchkins or Family Photo Album, developing individualized electronic books for the children with photos, text, and sound (recorded in their own parent's voice). The involvement of young children socially legitimized parents' working with low readability materials, just as in any family literacy programme. Having parents and teachers work together with young children is likely to enable informal peer support and help reduce adult anxiety and technophobia. Detailed outcome evaluation is pending, but future developments include the opening of family learning centres providing neighbourhood access to the technology. This is hoped to become a regular feature of Head Start, Evenstart, Title 1, and other services for the disadvantaged.

Many local public libraries have installed computer terminals with Internet access for free use by community children and adults, especially with the advent of metropolitan and rural area networks. However, access to a machine and support in learning to use it are both needed.

Nevertheless, it will not do to become obsessed with computers. Simpler, less expensive, and more widely available multimedia technology, used imaginatively, has much to commend it -- like an audiotape player. A broader range of such electronic software and hardware is considered in a parallel section of this hypertext (see the section "Audio and video for home literacy"). The main stem hypertext continues to discuss global electronic literacy developing in the home independently of the school.

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Global electronic literacy from the home

It has been suggested that the hearth was the focal point for the family in the 19th century, the television was in the 20th century, and the computer will be in the 21st century -- with the advantage that computer use is much less passive than watching TV.

It has also been said that it takes a whole village to raise a child. However, the traditional

stereotype of a school at the centre of a village community is being replaced by the notion of a global electronic village.

Parents and children are already interacting electronically independently of the school. The National Parents' Information Network (NPIN) is a project sponsored by the Education Resources Information Center (ERIC) in the United States to provide information directly to parents and those who work with parents. It also features an e-mail discussion listserver (Parenting-L) and a search and question answering facility -- a veritable electronic guru. Teachers can now assume that parents might have access to a second opinion at the speed of electricity.

As might be expected, NPIN includes "guidelines for helping you evaluate computer use in your child's school" - a subject on which parents can now easily be as expert as teachers. Just as some privileged children always enjoyed more frequent individualised teaching of reading at home than at school, the same is now true of learning information technology skills. Also accessible are The Electronic Schoolhouse, Family Village, Parents as Teachers National Center, SMARTPARENTING On-Line (accessible through NPIN), and Keeping Kids Reading (accessible through NPIN), all of which include resources for parents as educators at home. There are also various Web sites which contain reviews of educational software by and for children and parents, such as Parents, Educators, and Publishers.

Parents and Children Together Online is an interactive electronic magazine for parents and children, in this case specifically focused on family literacy and operated by the Family Literacy Center at ERIC. Electronic contributions from children and parents are welcome. Also see Parents Place and Family World (accessible through NPIN). Similar developments are occurring on a smaller scale in the United Kingdom, where the Parents' Information Network (PIN) (1996) has produced "A Parent's Guide to Computers Supporting Homework" to supplement previous guides on choosing software. All of this is just the beginning.

Electronic distance learning

Taking a wider age perspective, distance learning can now be delivered worldwide to students through the Internet, as can multiple-choice examinations (which are then electronically scored and interpreted). Assessment of essay-type responses is already being undertaken globally: electronic essays are wired or beamed to India and South East Asia to be graded (the rates of pay are less expensive than in the west).

Personal tutorial assistance from professionals is already delivered to distance learners by electronic mail. There are also organisations offering "teletutoring" through e-mail and the Internet, not only by professionals but also by volunteers and peers. Chan and Chou (1996) describe computer simulation of a learning companion in a reciprocal tutoring system -- a "virtual" peer tutor.

Computer-supported collaborative distance learning is now considered pretty ordinary (Abrami & Bures, 1997; Katz, 1996; Koschmann, 1996), and computer-supported distance collaborative writing projects are developing (such as Bonk & King, 1996). The scope for neologisms is vast: consider "distributed cognition" through "teleapprentices" in the "collaboratory." A current example relevant to electronic literacy in school and home is the

ReadIn project.

Already many universities and colleges have their newer student residences fully wired and networked so students can search the library catalogue, review literature, compose an essay, take a test, and receive a progress report without ever getting out of bed. Especially in metropolitan areas, local area networks might soon enable many children with computers at home to relate to their school in a similar way. Sound improbable? It is already happening. Israeli schoolchildren at the Metro West school near Tel Aviv who have missed a day's lessons can retrieve the information through networked links from home to the school's central database. McTaggart (1996) described a high school in England from which an Integrated Learning System (a system consisting of an adaptive combination of computer delivered learning materials with integral assessment of learner understanding) is networked into students' homes. (Though there might be difficulties with lunch and physical education!)

Beyond this, each class could have its own listserver for computer-based distributed cooperative learning amongst the students in their own homes. The school will have become a "virtual school" -- accessible to any member of the family of any age or level of literacy in the privacy of their own home. Again, this may sound improbable, but there are already several virtual schools in existence. Check out the Virtual School Distributed Learning Community, the Virtual Homeschooler's Co- op, the Virtual School of Winona, the Maryland Virtual High School, Project LEAP (Satellite Literacy Training Network), SkooMOO, and GrassRoots (the last in English, Spanish, Inupiat, Hebrew, Italian, Polish, and Finnish).

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Future problems

It is easy to become over-enthusiastic about information technology. Although these developments are happening, of course they are not necessarily a good thing, and must be evaluated in relation to sound pedagogical principles and empirical research. On the other hand, it is often easy to deflect potential infringements to our comfort zone by pseudorational appeals to pedagogical principles which are themselves little more than statements of philosophical belief.

Naturally, these new developments and challenges will present problems. Will electronic literacy make our children lazy and dependent? Remember Plato strongly objected to his thoughts being written down -- he thought it would make people lazy and lead to the decline of the oral tradition. Maybe he was right. Similar complaints have been made about automobiles. Simplistic and poorly designed software used thoughtlessly might indeed have this effect. Much software is still very unintelligent. However, like money, electronic technology has no intrinsic power for good or ill -- it is what humans do with it that makes the difference.

Teachers and parents also might be concerned about the richness and complexity of the electronic hypertext and hypermedia environments. Will some (or maybe all) children find hypertexts too difficult to learn to navigate with understanding? How do teachers focus them on the prescribed curriculum when the hyper"textbook" has a thousand tangents? If

children already have difficulty paying attention and concentrating on regular books, how can they cope with the multiple distractions inherent in hypertexts? Will access to hypertexts result in the "bells and whistles" syndrome: short-lived enthusiasm on account of novelty accompanied by shallow understanding and superficial responses?

Of equal concern is the question of whether electronic literacy will merely further advantage the already advantaged, creating further divisions and widening gaps in society. Clearly, the wide availability of inexpensive, simple, durable, and compatible hardware is a priority and a matter on which schools are well placed to give parents impartial advice.

Public libraries will need to provide free access to networked computer terminals with connections to the Internet and will need to lend text discs and text readers and software rather than books. As noted, some projects already involve the home loan of laptop computers to families. A complete PC undoubtedly represents an excess of complex computing power for some purposes, and less expensive, simpler alternatives dedicated to more specific operations are increasingly likely to be developed.

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Future opportunities

Clearly, electronic literacy in school and home presents many opportunities, but confidence and resources are limited for new challenges. Menus of options are needed, so each teacher, each family, and each school can develop a strategic plan which suits their own context and purposes.

New methods should help children and adults -- perhaps especially those with restricted literacy, special needs, and English as a second language, fulfill their potential by individualising and enhancing learning. The nature of learning (and certainly of schooling) will change in the face of the torrent of information. The traditional emphasis on detailed knowledge and retention will be replaced by more emphasis on transferable skills in selecting, processing, transforming, evaluating, and adding to information -- in other words, thinking. Higher order thinking skills will be increasingly in demand and directly taught in schools. Information retained in the brain will be largely "nodal knowledge" -- signposts, frameworks, and strategies for navigating networks.

Many routine, laborious tasks (like writing) will be taken over by machines, and tasks retained by humans should be performed much more quickly with computer assistance. It is hoped that the time saved will enhance the quality of human functioning and life. Certainly the maximizing of feedback and accountability through computers should release valuable teacher time currently spent on testing, scoring, compiling reports, and doing other administration. Perhaps teachers will be able to teach more, not less! That saved time could be devoted to developing yet more electronic literacy activities.

Electronic literacy also can offer the opportunity for expanding horizons while retaining privacy. The traditional book has always been valued for "taking you out of yourself," maybe to strange, exotic, and mind-expanding places. Electronics can do that even more powerfully -- again, for good or ill. Certainly using the Internet offers the chance to hold conversations with others in other parts of the world, generating a more global, less

parochial view, and seeing foreigners as real people with similar concerns to ourselves. Conversely, it also offers a private world, which may provide escape or confidentiality or the absence of public competition, so the learner (whether child or adult) feels less fear and shame. It is easier for a child to tell his or her friends that he or she is doing computer work than that he or she is having extra reading lessons.

Will print even survive -- albeit only as a retrievable electronic file? Perhaps not. Beyond hypermedia lies the world of virtual reality: the child wears a headset rather than looking at a screen, and every turn of the head or every word uttered by the child creates a corresponding change in the events being perceived. Interactive virtual reality "books" will not be read, but sensed -- indeed, they will be lived. Askov's (1997) "Microworld" programs already offer multisensory simulations of work tasks with literacy and numeracy components coupled with assessment and feedback.

If communication over space and time is reduced to a process of digital electronic transfer, what use are the crude symbols on which we currently rely? And if we no longer use these symbols, no longer either read or write them, will we retain any concept of "literacy"? As competence in dealing with these symbols becomes an archaic and esoteric hobby for the few, like archeology, differences and difficulties in literacy will disappear. There will be lots of communication, but not as we know it.

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Effectiveness

The research agenda for electronic literacy is substantial. Issues of effectiveness, comparative effectiveness, and cost-effectiveness should be to the fore. Just because it is electronic does not necessarily make it better or less expensive or easier or more reliable. At this stage much is speculation. Let us not assume that our speculations are true or factual in the absence of proper data -- or let our prejudices divert us from seeking proper evidence.

Computer-based learning is relatively expensive and therefore needs to demonstrate high effectiveness if it is to be widely espoused (Kulik & Kulik, 1991). However, past evaluations of out-dated software cannot be compared to current developments. Continuing comparisons of cost-effectiveness with more traditional low-cost approaches are necessary. Nonetheless, serendipitous spin-off may be expected, so the evaluation net should be wide but fine.

Inexpensive, simple, durable, and compatible hardware coupled with intelligent, interactive, and adaptive software and developmental menus of strategic practical options suitable for many different contexts and participants will be necessary if electronic literacy is to make a real difference. Quality organisational implementation of local initiatives will be important, especially for first ventures. The quality of people will thus clearly remain the most crucial ingredient for success.

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A glimpse into the future

Some developments mentioned previously will be mainstream before the next century, some within a decade. However, the possibilities beyond then challenge our imagination.

Try to imagine a regular home a few decades in the future. Pocket-sized portable televideophones enable all members of the family not only to talk and wave to one another or anyone in the world, but also to receive e-mail, ask questions of or give instructions to their home computer, and instruct their home printer to create a hard copy of their dictation, or fax it elsewhere. All of this is done with as much spoken feedback, assistance, prompting, and checking from the machine as the user requests or needs. Those needing relaxation can dial up a book or a radio or satellite TV programme, or slip a credit card-sized disc of a book into the text reader slot.

The bigger static terminal in the home is used mainly for bigger visuals, whether for education, communication, or entertainment. "Environmental print" is now in the global hyperspace of the Internet, and the kids help out their parents, who are a little slow with new stuff. Different family members relate electronically to friends all over the world, finding those with shared interests through electronic newsgroups, bulletin boards, and family home pages on the World Wide Web. Down the wire they also contribute text and pictures to newsletters and magazines about their special hobbies, without any inhibition since their efforts are automatically electronically checked and corrected for errors of style as well as syntax and spelling. They search the Internet globally for interesting educational courses and job vacancies, since many educational experiences can now be individualised and accessed from anywhere and many tasks can be carried out from anywhere. Selection for entry to educational courses and jobs is by computer-based assessment through the Internet; some applicants receive a decision within seconds.

The public library, or "Open Terminal" as it is now known, provides yet bigger visuals, facilities far large group video conferencing, and access and network facilities for everyone. Programmes for learning to read, with continuous diagnostic assessment, together with all books in print, are widely available on the publicly funded Internet channel, with hardware, home connections, and maintenance funded for the less advantaged by the local education authority. Books are cherished as antiques by many, although the younger people are beginning to forget what they were used for.

Postscript

Oh, and -- of course, this hypertext went out of date while you were navigating it. However, its external links are constantly being updated by the external Web site hosts. Over time, a few links will be temporarily inaccessible; one or two will disappear entirely. As with a river, you can never step into the same hypertext twice.

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Parallel section

Audio and video for family literacy

Using audiotaped readings of books is hardly a new idea. As early as 1968, Neville noted that listening to a reading or recording of a text while following it visually helped increase reading fluency. A further study of 180 children of normal reading ability showed the slowest of three speeds of simultaneous listening resulted in the highest level of comprehension (Neville, 1975). Johnson (1982) found a gender differential, suggesting boys might be especially helped in this way.

Commercial audiotaped books have become much more widely available over the last decade, catalogues now listing thousands of titles at varying levels of readability. Such tapes usually give a good model of lively and expressive oral reading. Alone, they can serve to develop listening comprehension. Together with a printed version of the same text, they provide an excellent opportunity for children to rehearse a text through listening before seeking to read the text by themselves -- not so much "repeated reading" as "repeated listening with reading."

Audiotaped books provide a continuous and unselected listening comprehension prompt, which supports decoding only if the student also pays sufficient attention to the visual characteristics of the word. They are thus less discriminatory and adaptive than computerized "Talking Books," in which the student has to choose to hear the auditory prompt. But they are relatively inexpensive.

Effectiveness

The use of audiotaped books in school, alone or in synchrony with the text, has been described in several reports in recent years (see, for example, Allison, 1991; Bircham & Shaw, 1997; >, Gamby, 1983; Gibbs, 1991; Johnson, 1983; Shuman & Cunningham, 1979).

Lane (1987, 1990) described the Aural Read Respond Oral Written (ARROW) system, combining a taped model with recording and replay of the student's rereading. Shapiro and McCurdy (1989) evaluated simultaneous tape-text reading of single words by learning disabled children, yielding improvements in reading accuracy on single words but no generalisation to the reading of passages. Medcalf (1989) compared a Tape-Assisted Reading Programme (TARP) with peer tutoring using the Pause Prompt Praise technique (Glynn, 1996) with low-progress readers aged 9-11 years. TARP involved simultaneous repeated tape-text readings at home and school followed by the child reading samples of the text unaided to the teacher. Both groups made gains on a norm-referenced reading test.

Variation in speed

Dring (1989) and Rosen-Webb (1992), working with secondary school children, both noted difficulties for weak readers with the speed of reading on commercially produced tapes used simultaneously with the text. Also, some commercial tapes were found not to follow the text exactly. Dring (1989) therefore produced tapes of books read at various speeds for use at school and home, creating a graded audiotape library. Volunteer adults were recruited to help record the slowed tapes. Those using the tapes regularly made more progress on a norm-referenced passage reading test than those who received regular teacher-led reading and language work, whether over a one-year or two-year period.

Similarly, Rosen-Webb (1992) cited evidence of reading test progress for some members of a small group of children with specific learning difficulties, although no control group was used.

Shany and Biemiller (1995) enabled their experimental tape-assisted group to control the speed of the tape recorder. Tape-assisted reading practice significantly improved reading rate, quantity of reading, reading comprehension, and listening comprehension for the experimental group as compared to the control group, although decoding ability (especially out of context) was not better. Reading comprehension gains were larger for students with large initial discrepancies between listening and reading comprehension.

For low-level readers, Carbo (1978; 1992) likewise recommended recording taped books in small chunks, with a slow pace and short phrases. More recently, Skinner, Johnson, Larkin, Lessley, and Glowacki (1995) experimentally compared fast-taped and slow-taped words with elementary school children with learning and behaviour problems, controlling for the novelty and attention effect of pre- and postassessment. Both taped interventions yielded gains compared to control conditions, some children gaining more from fast-taped materials and some more from slow-taped materials.

It cannot be assumed that an audiotape of a book, commercial or created, is automatically accessible to all children who might wish to enjoy it. Just as books are construed to have a "readability" level related to reading comprehension, so tapes can be considered to have a "listenability" level related to listening comprehension. Where a child chooses a tape of a book whose readability level is not greatly above the child's independent reading level, the listenability of the tape is unlikely to be too challenging. However, if the gap between the child's independent reading level and the readability of the taped book is high, then the tape will need to be slower to increase its independent listenability (or some other form of support or scaffolding should be made available).

English as a second language applications

With the extra support of the audiotape, children may be able to attack books of more challenging content and readability. In the family electronic literacy context, the tape and text combination can scaffold the interaction between parent and child as they enjoy the content together. Additionally, for families for whom English is not the native tongue, dual language texts can be accompanied by dual language tapes. A dual language text typically gives two versions of the same information to an opening: English on the left-hand page, native tongue script on the right. A dual language tape typically gives a continuous English reading on one side of the tape, a native tongue reading on the other side.

Jungnitz (1985) described the use of dual language audiotapes and texts with ESL families from the Indian subcontinent in a family literacy programme. The project was generally successful, but audiotapes were not used with all families and the effects of the tapes per se were not partialled out.

Read-along audiotapes with rehearsal, reading, and rereading were found particularly effective in promoting growth in accuracy, fluency, confidence, and motivation in first-grade ESL students by Koskinen, Blum, Tennant, Parker, Straub, and Curry (1995), who give useful practical advice about project organisation.

Practical considerations

The great advantage of the audiotape is that the replay hardware is inexpensive, simple to operate, and durable. Many homes already have a tape replay facility. Those that do not may be loaned a player by the school or other agency without incurring prohibitive cost or excess anxiety about damage or loss. Importantly, virtually all school and domestic audiotapes are the same size and totally compatible. However, audiotapes are difficult to make interactive, intelligent, and adaptive. A book is static, while the tape is dynamic, and synchrony between the two can be problematic.

Different ways of creating new tapes and using existing tapes therefore need to be identified to make tapes more adaptive to pupil needs. A number of factors merit consideration:

- Use of tapes before reading the text, during it, or both?
- Single exposure or repeated listening and/or reading?
- Listening or reading with or without support from an adult?
- Normal or slow or very slow tape speed?
- In school or home or leading from school to home?

Creative practitioners can then combine various factors to generate examples of approaches to test out. These might include the following:

- Creation of a library of audiotapes in school for school and home use, graded and coded according to the readability of the text and the listenability of the tape. Different speeds of reading could be recorded on either side of the tape.
- Use of audiotapes only at home for listening with an adult, encouraging pauses for discussion.
- Live readings of text to whole class by the teacher, followed by children taking tape and text home.
- Use of audiotapes only, then tape and text, for rehearsal in school, followed by reading of text only at home with parental or sibling feedback and discussion.
- Use of audiotape only, then tape and text, for parent only at home, to rehearse text prior to reading the text with the child at home (particularly where the parent has restricted literacy).
- Use of audiotape and text independently by child at home, followed by computer assisted self-check on comprehension of text by child in school, facilitating monitoring by the teacher.

Video

Many homes in developed countries also have a television and video player, even if relatively socioeconomically disadvantaged by that country's standards. Domestic videotape for static recorders shows a fairly high degree of compatibility (but not so high as audiotape), although portable camcorders are more variable.

Swan (1996) has shown that the insertion of video even into an enriched hypermedia environment yields additional achievement gains. Somewhat surprisingly, there is little

literature on the use of video for family literacy activities, although in 1993, Koskinen, Wilson, Gambrell, & Neuman evaluated the use of captioned video for literacy development in school, and the International Reading Association has a special interest group on this topic. Of course, broadcast network educational TV programmes can be recorded in school or home and viewed and discussed at leisure in the home.

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